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* Title: Development of Semi-Empirical Damping Equation for Baffled Tank with Oblate Spheroidal Dome				
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JANNAF PIB / 11th MSS / 9th LPS / 8th SPS Joint Subcommittee Meeting 5 – 9 December 2016

Abstract Due Date: Monday, 11 July 2016

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Unclassified Abstract (250 – 300 words; do not include figures or tables)

* Propellant slosh is a potential source of disturbance that can significantly impact the stability of space vehicles. The slosh dynamics are typically represented by a mechanical model of a spring-mass-damper. This mechanical model is then included in the equation of motion of the entire vehicle for Guidance, Navigation and Control analysis. The typical parameters required by the mechanical model include natural frequency of the slosh, slosh mass, slosh mass center location, and the critical damping ratio. A fundamental study has been undertaken at NASA MSFC to understand the fluid damping physics from a ring baffle in the barrel section of a propellant tank. An asymptotic damping equation and CFD blended equation have been derived by NASA MSFC team to complement the popularly used Miles equation at different flow regimes. The new development has found success in providing a nonlinear damping model for the Space Launch System. The purpose of this study is to further extend the semi-empirical damping equations into the oblate spheroidal dome section of the propellant tanks. First, previous experimental data from the spherical baffled tank are collected and analyzed. Several methods of taking the dome curvature effect, including a generalized Miles equation, area projection method, and equalized fill height method, are assessed. CFD simulation is used to shed light on the interaction of vorticity around the baffle with the locally curved wall and liquid-gas interface. The final damping equation will be validated by a recent subscale test with an oblate spheroidal dome conducted at NASA MSFC.

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- > Direct questions to Shelley Cohen, by phone at 410.992.7302 x 215, or email to scohen@erg.ihu.edu.

Form Date: 5/25/16